Debuncher Stochastic Cooling

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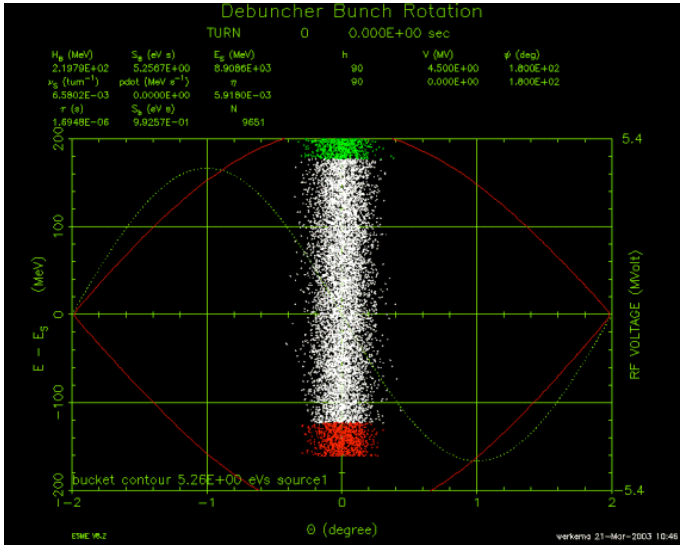
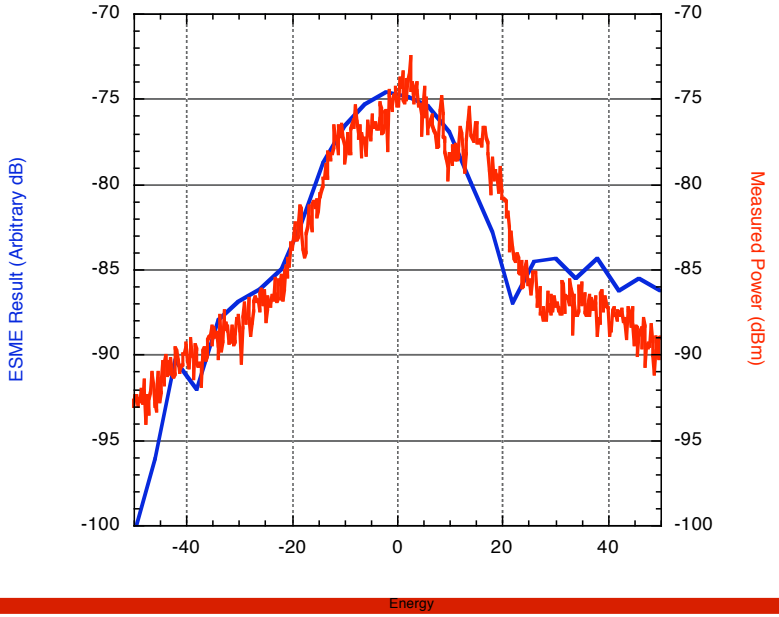
Debuncher sequence

- Bunch rotation: ~100 msec
  - Exchange
    - large momentum spread (~4%)
    - short time spread (~2 nsec)
  - For
    - Small momentum spread (0.4% or 36 MeV)
    - DC beam
- Stochastic cooling
  - Momentum and transverse
  - Liquid He front end (T_{eff} = 30 K)
  - 4-8 GHz in 4 bands
  - 2400 W/plane (transverse), 4800 W (longitudinal)
  - Cooling Specifications:
    - Momentum: 60 MeV to 6 MeV in 1.9 seconds
    - Transverse: 320 π mm mr to 45 π mm mr in 1.9 seconds

Bunch Rotation

- Large initial momentum distribution after Bunch Rotation
  - Large time spread from MI ~ 2 nsec
- Energy offset contributes to width and produces high energy tail
  - Hardware in place (B. Ashmanskas, Cornell) to fix energy offset
  - Implementation in operations in coming weeks



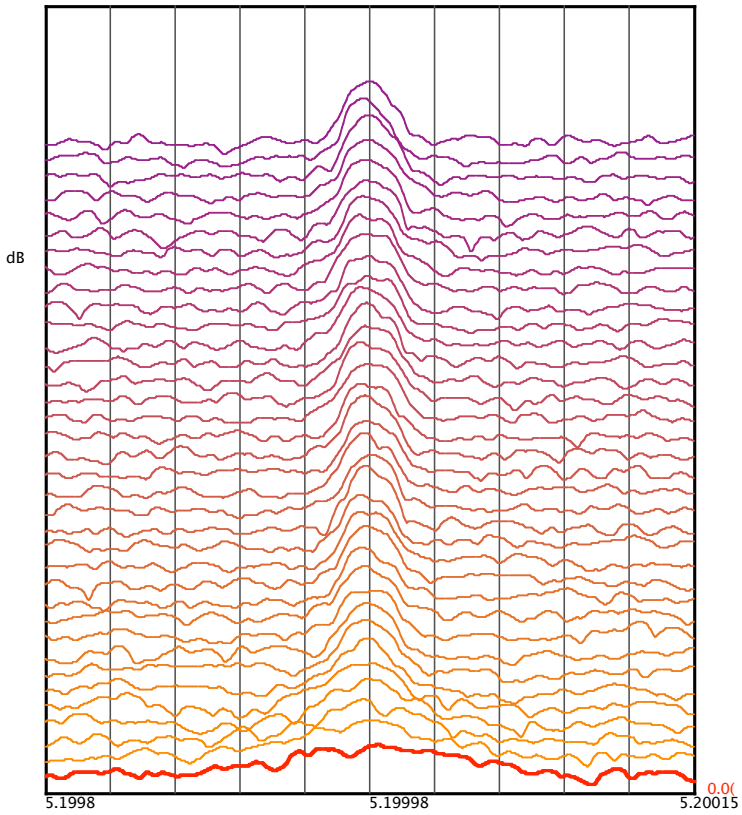


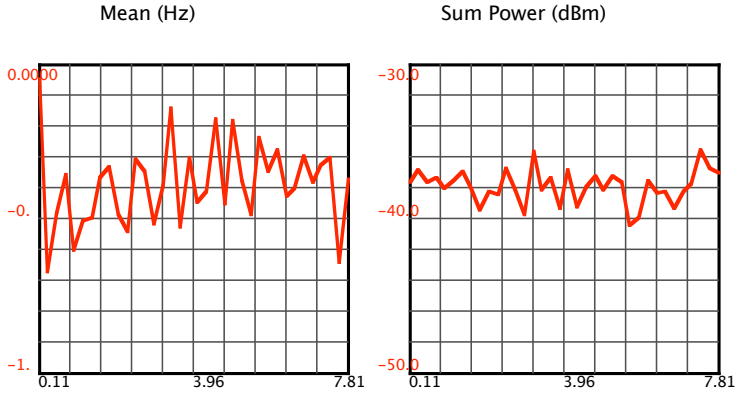
Measurement technique

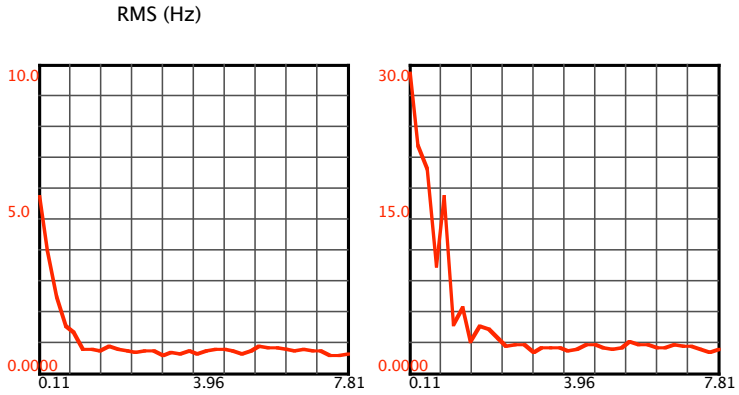
- Measure cooling rate and asymptotic width
- Use 95% width
  - How far stacktail has to move beam to get 97.5% efficiency
- Look at one Schottky band
  - 5.2 GHz
  - 8813th harmonic
  - Uses Debuncher Momentum Band 2
- Spectrum Analyzer:
  - Center 5.2 GHz
  - Span 0 Hz
  - Resolution Bandwidth 1 MHz
  - Use 21.4 MHz IF output
- Vector Signal Analyzer
  - Center 21.4 MHz
  - Span 350 KHz
    - ~100 MeV/c at 8813th harmonic
  - 7 averages
  - Traces every 0.22 seconds
  - Start at end of bunch rotation
  - 5 Pulses

Sample pulse

PALLD2F2.TXT

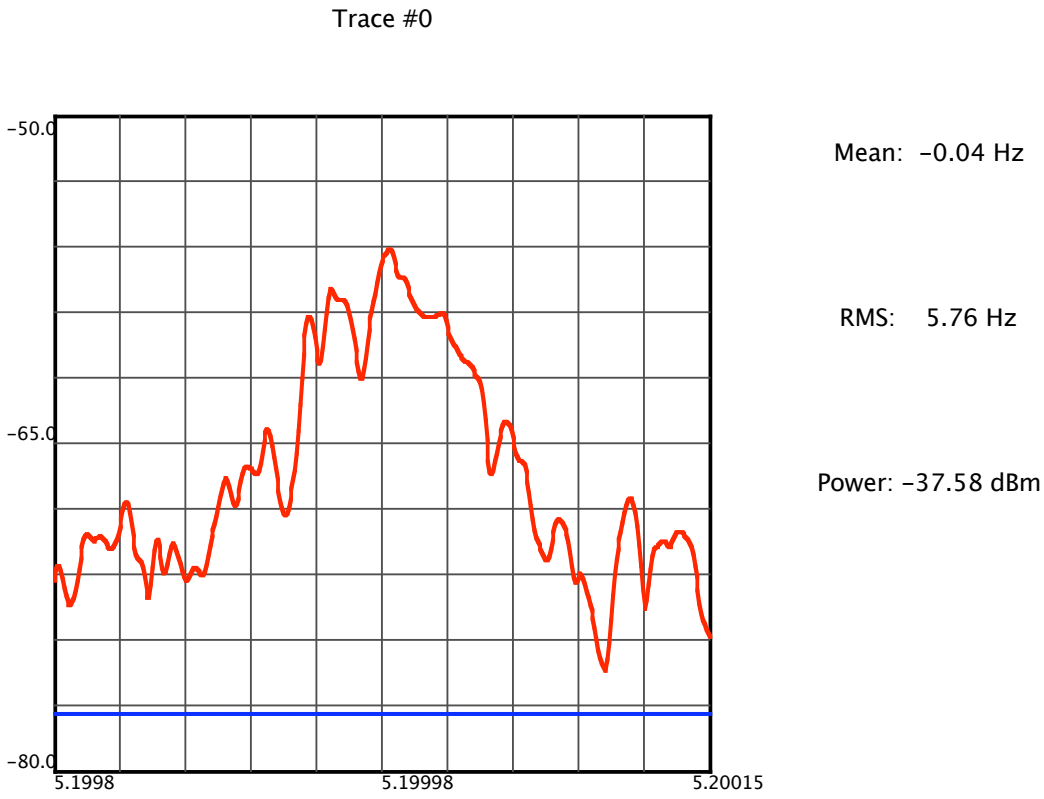






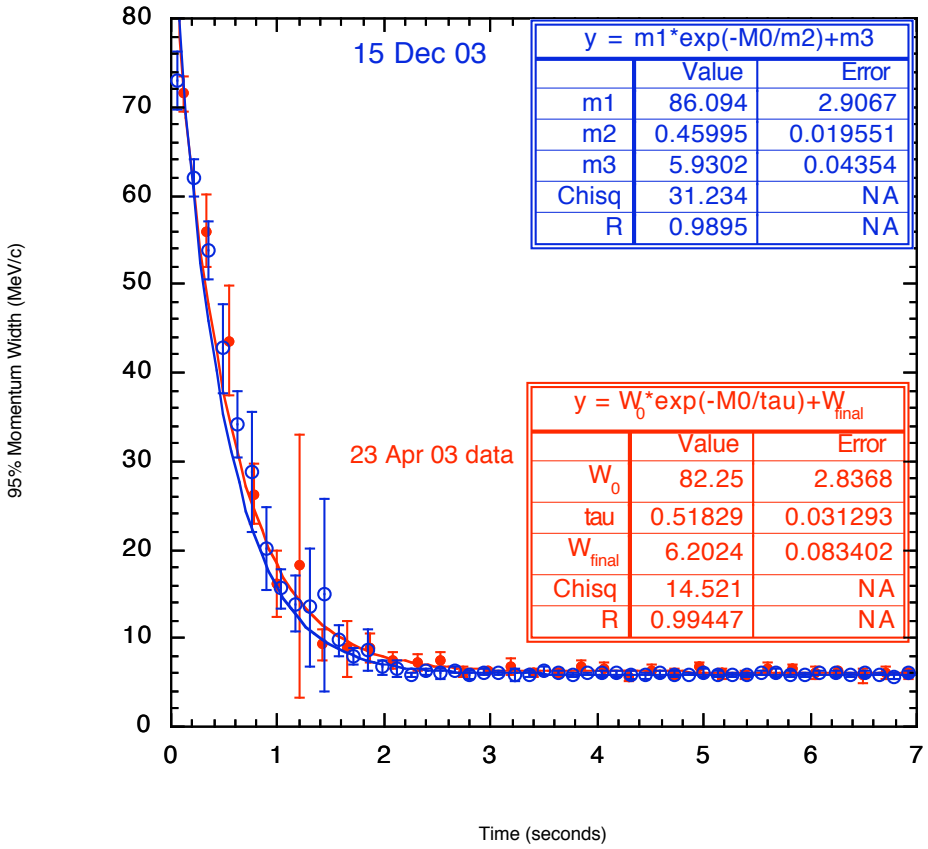
Initial Width

- Initial beam distribution > 100 MeV
- Function of bunch rotation performance
- Beam outside of span move into span
  - Cooling reach ~110 MeV
  - Beam outside of cooling reach heated, N+1 harmonic overlap
  - Can affect 95% width calculations



Performance

- 5 Pulses: plot average and RMS of the 95% width
- Fit to exponential + constant
- Reworked Medium level
  - Installed variable gain attenuators
  - Variable gain amps run at constant gain
  - New equalizers
- Optical Notch filters coming!



Desired Performance

- Debuncher 95% Width: $W = W_0 \exp(-t/\tau) + W_a$
- Stacktail Cooling sets cycle time $t = W/3$
- With DRF2 on: $W_0 = 80 \quad \tau = 0.45 \quad W_a = 6.9$

  Solution: t = 2.42, W = 7.28 MeV/c

- Future? $W_0 = 36 \quad \tau = 0.39 \quad W_a = 4.0$
  - Optical notch filters: more gain and smaller asymptotic width
  - Bunch length on target and Bunch rotation alignment: initial width

  Solution: t=1.5, W=4.5 MeV/c

Transverse Systems

- Bands 1 & 2 have large common mode signals, which limit gain (as total power is limited)
- Notch filters under design to minimize impact of common mode
- Installed in Fall 03 shutdown
- Working on similar measurements of transverse performance